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THE PACIFIC OCEAN[1]

By Dr. H. U. SVERDRUP

SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA

THE Pacific Ocean can be discussed from a number of different points of view. One could deal with the history of its discovery and exploration from the time of Magellan's long and perilous journey up to the present day when clippers of the air cross and recross the ocean in a few days, or one could discuss its importance as a highway of the sea carrying trade between large surrounding countries, or one might consider it as determining the routes for the migration of man and the spreading of culture from island group to island group and from continent to continent. I shall not attempt to discuss the Pacific Ocean from any of these points of view, but shall, instead, deal with the water masses themselves and with the systems of prevailing currents, and shall indicate how the ocean influences the climate and the weather of the surrounding land and how the productivity of the sea, which is becoming increasingly important to the economy of man, varies from one region to another because of the character of the currents.

As a starting point let us examine the distribution of surface temperature over the Pacific Ocean in the month of August. The striking features are, in the first place, the vast extent of the tropical areas in which the surface temperature is very high, above 24° C. (75° F.), and, in the second place, the tongues of low temperature which extend towards the Equator along the western boundaries of the ocean, that is, along the coasts of North and South America. Due to the intrusion towards the Equator of these cold

[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 147.

waters the width of the tropical region is much smaller on the American side than on the Asiatic-Australian side. This contrast between west and east is closely related to the character of the currents, and we shall later on return to this relationship. The point which will be emphasized now is that the surface waters of the Pacific Ocean are very warm over large areas in the tropics, moderately warm over smaller areas in middle latitudes, and cold only in high northerly and high southerly regions.

Observations of the temperature at subsurface levels show, however, that only a relatively thin surface layer is heated and that the enormous water masses which fill all the deep basins of the Pacific Ocean are cold, having a temperature which lies less than 2° C. above freezing. Thus, to the south of the Aleutian Islands the very surface waters in summer are moderately warm, but below a depth of 60 meters the temperature varies between 3° and 1.6° only. In the trade-wind region in the North Pacific high surface temperatures are encountered, but below a thin top layer the temperature decreases rapidly with depth and below 1,500 meters again remains below 3°. In the region of the trade-winds of the Southern Hemisphere a similar temperature distribution is found. In 50° S near the center line of the South Pacific, the temperature is above 5° down to a depth of 900 meters, but below 1,500 meters is nearly the same as that observed in the other localities.

Below a depth of 2,000 meters the salinity of the Pacific waters is nearly constant, the salt content varying only between 34.6 and 34.7 parts per thousand (per mille), that is, only by about 0.1 gram in one kilogram of water.

The deep water of the Pacific is of greater density than the waters near the surface, and in the Pacific as well as in all other oceans we find the water masses arranged in stable stratification, that is, we always find the denser waters near the bottom and the lighter water masses at the surface. Now, the density of the ocean waters is changed only when the water is in contact with the atmosphere where it may be heated or cooled or where the salinity may be increased or decreased by evaporation or precipitation. In general, we therefore find certain regions where the surface waters attain a great density, and from where they sink to the level at which the density attained at the surface prevails. These are regions in which the subsurface water masses are formed. The formation of the uniform deep water of the Pacific was, however, for a long time puzzling to oceanographers because no region in the Pacific Ocean could be found in which such water was formed at the surface and sank towards the bottom. Over wide areas in the northwestern North Pacific the temperature is in winter as low or lower than the temperature of the deep water but the salinity remains so low that the water is much lighter than the deep water and can not sink towards the bottom. Similarly, in the Antarctic part of the South Pacific no sinking of cooled surface water takes place. The puzzle was solved when it was realized that the deep water of the Pacific is not formed in that ocean but originates mainly from the Atlantic Ocean, where sinking of surface water takes place both in high northerly and high southerly latitudes.

In the Atlantic Ocean deep water of high salinity (34.9‰) and relatively high temperature (2.5° C.) is formed to the north where the high salinity water of the Gulf Stream is cooled in winter and attains such a high density that it sinks to great depths. The salinity of the North Atlantic deep water over large areas is increased by addition of high salinity water flowing out from the Mediterranean. In the Antarctic region to the south of the Atlantic the density of the water is increased by cooling and freezing of ice, leading to the formation of a bottom water of low temperature (−0.6° C.) and moderate salinity (34.6‰). These two types of deep water spread south and north, respectively, and the spreading can be recognized in vertical sections showing tongue-like isotherms and isohalsines. Mixing takes place and, due to this, a fairly uniform body of water is formed to the north of the Antarctic Continent within the region of the circumpolar Antarctic Current which circles the Antarctic Continent as the greatest current of all oceans. Within the greater part of this body the temperature varies only between 2.5° and 0°, and the salinity between 34.65‰ and 34.75‰. In the Atlantic and Indian sectors the influence of the warm and saline deep water of the northern seas and the cold and less saline bottom water of the Antarctic is evident, but otherwise the striking feature is presented by the very small differences in temperature and salinity within the entire region. The water is particularly uniform in the Pacific sector and it is this uniform circumpolar water which spreads north and fills the entire basins of the Pacific, being slightly diluted by low salinity water from higher levels. In the South Pacific a vertical circulation provides for exchange of water with the Antarctic circumpolar water mass, but in the North Pacific such circulation is lacking. There the small inflow of deep water from the south appears to be compensated by an outflow to the Indian Ocean between the islands of the East Indian Archipelago.

A vertical section showing the distribution of temperature and salinity in the Pacific Ocean clearly demonstrates the point that on the whole the waters of the Pacific are very cold and that only a relatively thin surface layer is heated. Between the deep water and the warm surface layers intermediate water

masses of low salinity are present. These are formed partly in the Antarctic and partly in the Arctic regions of the Pacific Ocean and have their counterparts in the Atlantic.

Let us now return to conditions near the surface of the ocean in order to examine how the general distribution of temperature in the surface layers is related to the prevailing currents. Keeping in mind the picture of the distribution of surface temperature it is readily recognized that the regions of low temperature off the coasts of North America and South America are regions in which the general currents flow from higher to lower latitudes bringing water of low temperature closer to the Equator. In contrast the regions in the western part of the Pacific where extensive warm water masses are found are regions where the general direction of the current is from lower to higher latitudes such that warm water is carried away from the Equator.

The direction of the surface currents corresponds more or less to the direction of the prevailing winds over the different parts of the ocean, with such exceptions as must be expected because of the coast lines. Thus, the relatively narrow and swift Kuroshio off the coast of Japan is not directly related to the local winds but runs in winter partly against the wind, but this current must be considered as the necessary continuation of the North Equatorial Current which flows from east to west under the influence of the prevailing trade winds.

Among the surface currents of the Pacific Ocean there is, however, one which is not obviously related to the prevailing winds nor to the character of the coast lines, and that is the Equatorial Counter Current which is embedded as a narrow and swift current towards the east between the west-flowing North and South Equatorial Currents. The nature of the Equatorial Counter Current has only recently become clearly understood. It is explained as follows by Montgomery and Palmén: The prevailing trade winds exert a stress on the sea surface which, besides contributing towards maintaining the equatorial currents, also lead to a piling-up of light surface water against the western boundaries of the ocean. From oceanographic observations it is evident that such a piling-up takes place because off the American coast the thickness of the warm surface layer is as little as 20 meters, whereas off the Philippines and New Guinea the corresponding thickness is 200 meters or more. As a consequence of this piling-up the sea surface actually rises from east to west, the rise amounting to about 65 centimeters. This sloping surface has not been determined, of course, by precision leveling, but conclusions as to its existence are based on convincing oceanographic evidence. The slope in the trade-wind regions is balanced by the stress which the wind exerts on the sea surface, but between the trade wind regions lies the equatorial belt of calms where no wind stress acts on the sea surface. Therefore within the calm belt the water must flow downhill from the western to the eastern side of the ocean and the counter current represents this downhill flow. Frictional forces prevent the water from attaining as high velocities as would correspond to a free fall of 65 centimeters. If there were no friction a counter current should reach a velocity of nearly seven knots, that is, seven nautical miles per hour, when approaching the American coast, but the maximum velocity lies between 1 and 2 knots only.

Owing to the friction, a transverse circulation must develop within the counter current, which is quite shallow and confined to movement of the warm surface waters. Theoretical examinations by Defant lead to the result that this transverse circulation should have such character that water is drawn towards the surface at the northern boundary of the current and at the Equator, and sinks at the southern boundary of the counter current. Such a transverse circulation evidently exists in the Pacific, where detailed measurements of temperature, salinity and chemical constituents were made by the *Carnegie* in 1929. This circulation also has an effect on the distribution of organisms because wherever subsurface water is drawn towards the surface, conditions for development of organisms are favorable. The subsurface waters are rich in plant nutrients such as phosphates and nitrates and, when brought near the surface where there is light such that photosynthetic activity can go on, a rich crop of plants will develop followed by large populations of animals. During the crossing of the Equator by the *Carnegie* in 1929 net hauls were made for examination of the microscopic organisms, and according to these the variation in total plankton agreed perfectly with the above reasoning. Maximum amounts of plankton were found at the northern boundary of the counter current and near the Equator, where subsurface water was drawn towards the surface.

The counter current does not appear in the distribution of surface temperatures because it is a feature of the surface layers only, it is a shallow current which is found completely within one uniform climatological area, the Tropics. The other major currents are evident in the distribution of the temperature, as has already been pointed out, but from a chart of the surface temperature and also from a chart showing the character of the surface currents it appears as if all transitions in the ocean are gradual, as if the change in the character of the water when passing from lower to higher latitudes or from west to east

takes place in such a gradual manner that no boundary regions between different currents can be recognized. Examination of subsurface conditions reveals, however, that this impression is quite erroneous and that, on the contrary, well-defined water masses are present separated by relatively narrow regions of transition.

In order to recognize these water masses it is necessary to plot the data from the sea, particularly the temperature and the salinity, in a special manner. The procedure is best illustrated by means of a diagram (Fig. 1). In this diagram are shown the vertical distribution of temperature and salinity at two stations in the Gulf Stream off North Carolina. Examining these curves only there appears to be little similarity between the conditions at the two stations. Thus, at the one which was closest to the coast a temperature of 15° was encountered at a depth of 300 meters, whereas at the station at greater distance from the coast the same temperature was encountered at the depth of 650 meters. The discrepancy between conditions at the two stations disappears, however, if the observed temperatures are plotted against the observed salinity, as has been done in the diagram to the right. From this diagram it is seen that the water which at the one station was found to be between the depths of 277 meters and 461 meters is of exactly the same character as that found at the other station between 490 and 790 meters. Or, in other words, a definite relation exists between the temperature and the salinity such that within the same water mass the corresponding values of temperature and salinity fall on a well-defined curve. Therefore, by plotting the observed temperatures and salinity in a diagram one can recognize a given water mass of different character.

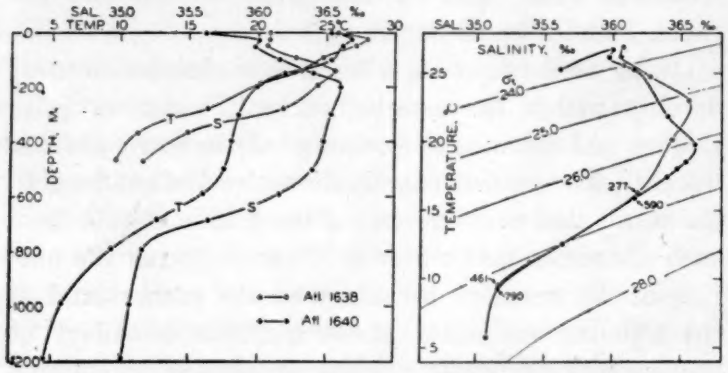

FIG. 1. *Left.* Temperature (T) and salinity (S) at two stations off Onslow Bay, N. C., plotted against depth. *Right.* Temperature and salinity at the same stations plotted against each other.

Applying this examination to the South Pacific, one finds there several well-defined regions within which typically different water masses are present (Fig. 2), the Subantarctic which occupies the southern part of the ocean and extends along the coast of South America to about 15°S, the eastern and western Central Water Masses and the Equatorial Water Mass, which is wide in the east and narrow in the west. The character of these water masses is shown in Fig. 3.

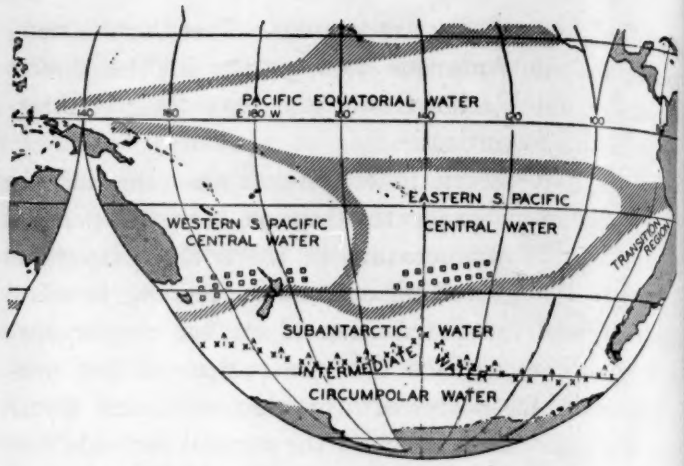

FIG. 2. Regional distribution of the water masses of the South Pacific. Areas in which the central water masses are formed are indicated by squares, area in which intermediate water is formed is shown by crosses.

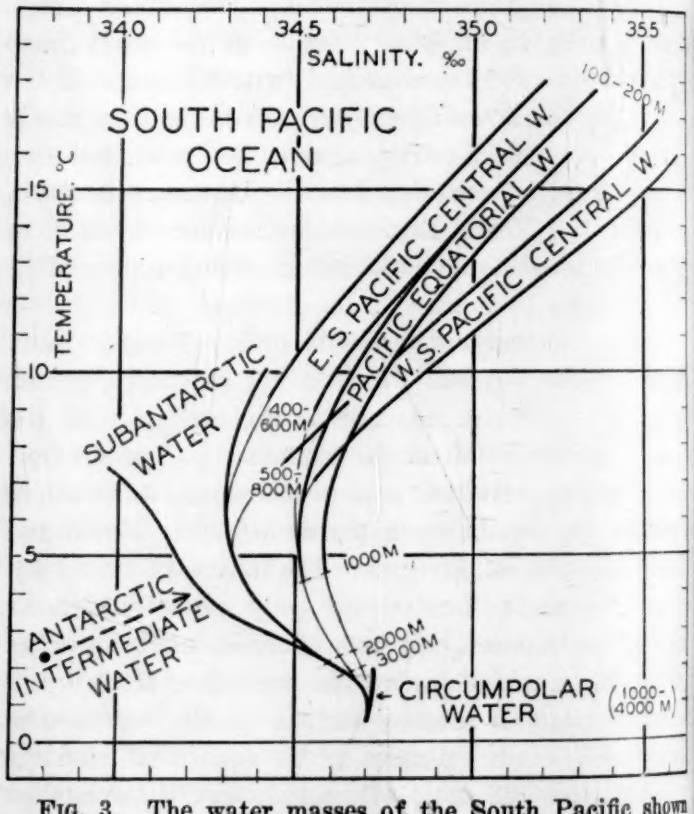

FIG. 3. The water masses of the South Pacific shown in a temperature-salinity diagram.

In this diagram no single T-S curves are entered but, instead, bands are shown, the significance of which is that corresponding values of temperature and salinity fall inside of the lines which represent the boundaries of the bands.

In the diagram the uniform circumpolar water appears as a short piece of a curve because the salinity of that water is nearly constant at 34.7‰ and the temperature varies only between 2° and 0.5°. The deep water below the other water masses is nearly

similar to the circumpolar water, as is evident from the fact that all curves converge at their lower ends. Above the deep water the Antarctic Intermediate Water shows up by its low salinity values and above this again are found the other water masses. The Central Water Mass of the Western South Pacific is similar to the corresponding water masses of the Indian and Atlantic Oceans, being formed in a similar manner under similar external conditions. The Eastern Water Mass has a somewhat lower salinity, probably because of admixture of Subantarctic water, and the Equatorial Water Mass is intermediate between the two and must, therefore, mainly originate in the South Pacific.

Turning to the North Pacific, we encounter a similar distribution of water masses. Again two Central Water Masses are present (Fig. 4), one small eastern

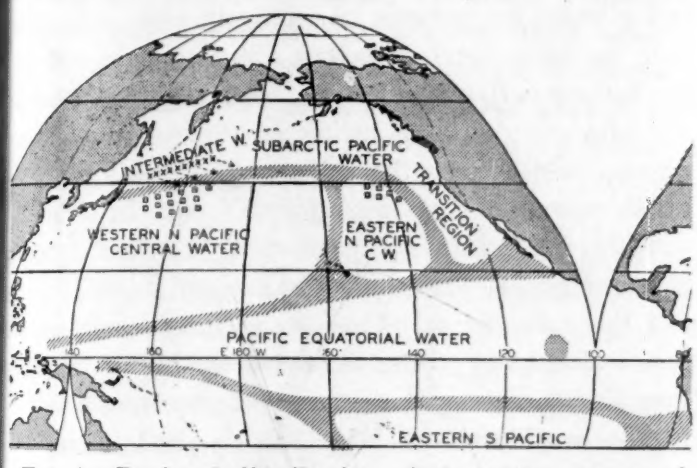

FIG. 4. Regional distribution of the water masses of the North Pacific. Areas in which the central water masses are formed are indicated by squares, area in which intermediate water is formed is shown by crosses.

and one large western, and to the north of them is found a large body of Subarctic water. It may be mentioned here that in the North and South Atlantic and Indian Oceans only one Central Water Mass is present, but in the North and the South Pacific Oceans two are found, probably because these oceans are very wide and because frequently two areas of atmospheric high pressure are present over these seas.

The character of the water masses can be illustrated by a diagram similar to that used for showing the water masses of the South Pacific (Fig. 5). Again, the uniform nature of the deep water is evident from the convergences of the different curves. Above the deep water intermediate water is present, but the formation of this intermediate water is more complicated and in some regions two salinity minima appear. The Central Water Masses are of much lower salinity than the corresponding ones in the South Pacific, indicating that the Equatorial Water Mass must originate in the South Pacific as was already pointed out. The Subarctic Water has a low temperature and a low

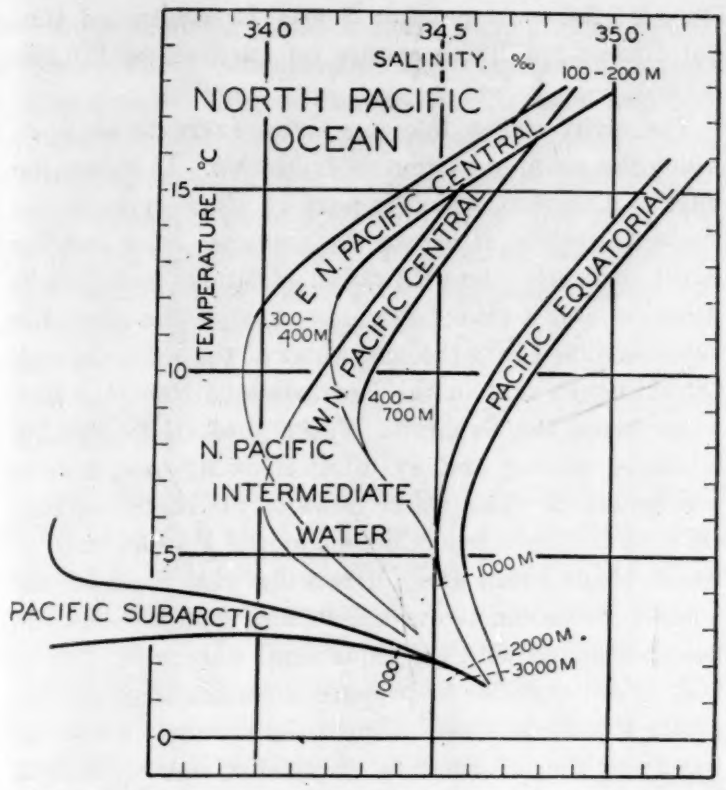

FIG. 5. The water masses of the North Pacific shown in a temperature-salinity diagram.

salinity which increases with depth until the values of the deep water are reached. The one feature to be stressed is that, except for the Eastern North Pacific Central Water Mass, these different water masses are all well defined and all are separated by relatively narrow regions of transition.

The circulation of the North Pacific can now be presented in a more definite manner than by maps showing the surface currents, because a chart can be prepared showing the general direction in which water is transported by the ocean currents and the amounts of water carried by the different branches. Such a chart is shown in Fig. 6 in which the transport by the different branches of the current system is given in millions of cubic meters per second. Thus the maximum transport by the Japan Current is as high as 65 million cubic meters per second, whereas the California Current carries about 10 million cubic meters per

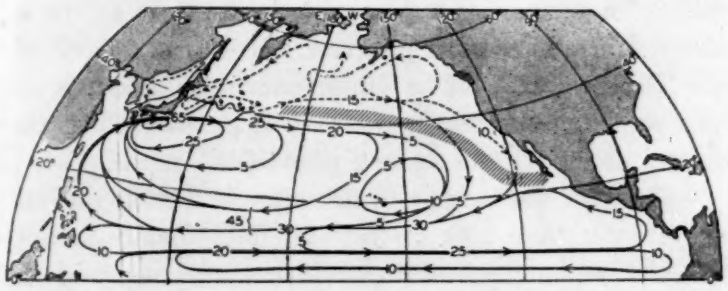

FIG. 6. Transport by the currents of the North Pacific. Lines indicate direction of transport and numbers give volumes of waters expressed as millions of cubic meters per second.

second. As a comparison it may be mentioned that the Mississippi River carries on an average 120,000 m^3/sec.

The chart shows the equatorial currents between which the counter current is embedded. It shows the intense Kuroshio, which is part of a big gyral in the western Pacific; it shows the presence of a smaller gyral between the Hawaiian Islands and North America, and it also shows how water of the Kuroshio becomes mixed with the cold water of the south-flowing Oyashio such that in the Northwestern Pacific a new water mass, the Subarctic Water Mass, is formed by intensive cooling and by dilution owing to excessive precipitation. This water flows to the east as a cold current, the Subarctic Current of the Pacific, part of which bends south and follows the west coast of the United States and Lower California, until it meets and becomes mixed with the Equatorial waters.

It is not possible to prepare a similar map for the South Pacific because sufficient data are not available, but from the information at hand it is certain that, in general, the currents of the two parts of the ocean are mirror images of each other. The California Current is a counterpart of the Peru Current, which is even more conspicuous and exerts a greater influence upon the distribution of organisms in the sea and upon the climatic conditions.

I have attempted to give a brief review of the structure of the water masses of the Pacific and the relation of prevailing currents to this structure. In conclusion a few words may be added as to the meteorological significance of our increased understanding of ocean circulation and as to the relation of the productivity of the sea to the water masses and currents. It has long been recognized that the oceans exercise a thermostatic control on the climate. The sea receives in summer a great surplus of radiation from the sun and the sky which in that season is mainly used for raising the temperature of the water, and in winter is given off to the air when cold winds blow from the continent, or is used for evaporation. Only recently has it been possible to examine more closely in what regions the heat is given off to the atmosphere and where the maximum evaporation takes place. According to a study which is now in progress, the warm waters of the Kuroshio give off in winter enormous amounts of heat as they flow north, whereas only small amounts are released over the eastern part of the ocean.

Off Japan the maximum amounts of heat given off are greater than 240 gm cal/cm^2/day, that is, about half the amount which in that region is received in summer. Similarly, the evaporation from the waters of the Kuroshio reaches in winter values greater than 0.8 cm/day, corresponding to a transfer of about 480 gm cal/cm^2/day of latent heat, or about as much as is received in summer. Evidently, the exchange of heat and the evaporation from the sea surface is closely related to the oceanic circulation and is very localized. Therefore, in winter the energy for the atmospheric disturbances in middle latitudes is supplied *by the sea in restricted areas*. These very areas have long been known to be those in which the atmospheric disturbances, the traveling cyclones, are formed, and the present results serve therefore to illustrate the close interaction between the atmosphere and the oceans.

As far as the productivity of the sea is concerned it should be borne in mind that the sea can support large populations of plants and, consequently, provide food to large numbers of animals only in regions where phosphates, nitrates and other plant nutrients are available in the surface layer where so much light penetrates that photosynthesis is possible. Phosphates and nitrates are present in relatively high concentrations in the subsurface layers where organic remains are decomposed, but in the surface layers the available amounts are depleted, owing to the activity of the plants, particularly the microscopic floating plants which represent the main animal food. In order to provide for continued production of plants, water from subsurface depths must be brought to the surface and this takes place in regions of intense mixing, in regions where in winter excessive cooling of the surface layer occurs such that convection currents reaching to considerable depths develop, and in regions where upwelling of subsurface water takes place. Upwelling of subsurface water is particularly conspicuous along the west coast of the United States and off the west coasts of Chile and Peru, and the waters off these coasts are known for their large fisheries. It may be enough to mention that during the last few years an average of about 500,000 tons of sardines have been caught off the American west coast and that according to estimates the amount of fish caught by the guano birds off Peru probably passes 3,000,000 tons a year. Regions of winter cooling and consequently thorough mixing to considerable depths are found in the Gulf of Alaska, around the Aleutian Islands, and in Bering Sea, where again fisheries of the greatest importance take place, and regions of intense mixing and partly of winter cooling are found around Japan, where probably the most intensive fishing in the Pacific is undertaken. The large open ocean areas are not devoid of life, but the populations do not reach such density that fishing operations can be undertaken with success. In the regions which have been mentioned and in regions adjacent to islands where considerable stirring occurs detailed and intensive work has to be carried out in order to learn more about the factors which control the productivity of the

sea and which place a limit on the extent to which the sea can be exploited. At the Scripps Institution of Oceanography we shall for some time to come continue an intensive study of the productivity of the waters off southern California as one of our major objects.

Many of the conclusions which have been presented here are based on meager data, and many features of the picture which has been developed may have to be modified. Only the average state of the ocean has been dealt with because oceanography has not advanced far beyond the descriptive stage and because the understanding of the processes which maintain the average conditions is still incomplete. The field before us is enormous and it is my hope that in the future increasing efforts will be directed towards further exploration of the largest but least known of all oceans, the Pacific Ocean.

OBITUARY

DR. EDWARD KREMERS

ON July 9, 1941, Dr. Edward Kremers, director emeritus of the School of Pharmacy of the University of Wisconsin, died of a heart attack after having undergone some operations (intestinal cancer) with good success. He was seventy-six years of age.

Kremers was born at Milwaukee, Wisconsin, on February 23, 1865, as the scion of one of the German families coming to this country in order to escape the events around 1848. At the School of Pharmacy of the University of Wisconsin he earned his Ph.G. in 1886 and his B.S. in 1888. During his study at Madison Kremers enjoyed the fortune to have as his teacher one of the greatest scientists American pharmacy has presented to the world, Frederick B. Power. Working with Power on the chemistry of volatile oils he learned of the classical investigations executed in the field of phytochemistry by the German chemist Otto Wallach.

In the fall of 1888 Kremers went abroad and became a student with Wallach first at Bonn and later at Goettingen. In Bonn he attended also the lectures on structural chemistry delivered by Kekulé, of benzene ring fame. These two branches of chemistry, *i.e.*, phytochemistry and structural chemistry, have remained the two main fields of Kremers's scientific endeavor throughout his life, and it was in them that he gained world-wide reputation. The dissertation with which he fulfilled the requirements for his Goettingen doctor's degree in 1890 dealt with "The Isomerisms within the Terpene Group" and laid the ground for many later investigations. Returning to Madison, Kremers was instructor in pharmacy from 1890–1892, professor of pharmaceutical chemistry and director of the course in pharmacy at the University of Wisconsin from 1892–1935, succeeding Power.

Being a pharmacist by choice and by destiny Kremers attempted to make pharmacy a profession standing on the same educational level as the other academic callings and to give the pharmacist and the service rendered by him the advantage of special knowledge as well as of a broad general horizon. That is the reason for the fact that he already in 1902 introduced a four-year course in pharmacy, the first of this kind on American soil, and was likewise the first to establish graduate work for students of pharmacy in America leading to the Ph.D. with pharmacy as a major. In 1913 Kremers initiated the first "Pharmaceutical Experiment Station" in the United States, thus demonstrating the possibilities and usefulness of academic pharmaceutical research. Furthermore, it was Kremers who initiated the organization of a Historical Section of the American Pharmaceutical Association in 1902 and created in that way the first organized pharmaceutico-historical group not only in the U. S. A., but in the world. It is likewise very probable that the courses in history of pharmacy as well as of chemistry, announced by Kremers for the first time in 1907–08, were the first of their kind to be held as recognized subjects of instruction at an American university.

Finally, tribute has to be paid to the editor and the author Kremers. From 1896 to 1909 he edited, first together with Frederick Hoffmann and from 1901 alone, *The Pharmaceutical Review*. In 1898 Kremers created another journal restricted exclusively to the publication of scientific originals. This journal, bearing the title *Pharmaceutical Archives,* was discontinued in 1903 and revived in 1936. In 1912 Kremers published his classical brochure on "The Classification of Carbon Compounds," which was reprinted in 1924. He collaborated on the National Standard Dispensatory (1909) and translated Gildemeister-Hoffmann's work on "The Volatile Oils" from the German original into English (1900 and 1913). The pharmaceutico-historical collections of Kremers have formed the main basis for the "Kremers-Urdang History of Pharmacy" published in 1940, the first book containing a systematic survey on the development of American pharmacy.

Kremers served the United States Pharmacopoeia Committee as chairman of the Committee on Volatile Oils from 1900 to 1910 and the American Pharmaceutical Association as chairman of the Scientific Section and as historian. He refused the suggestion to become president of the association, but was made its

honorary president for 1933–34. He was president of the American Conference of Pharmaceutical Faculties in 1902 and of the Wisconsin Pharmaceutical Association in 1930. The National Association of Boards of Pharmacy made him an honorary president for 1939–40. He was, furthermore, an honorary member of the Société d'Histoire de la Pharmacie and of the Deutsche Pharmazeutische Gesellschaft and a corresponding member of the Gesellschaft fuer Geschichte der Pharmazie. He was awarded the Ebert Prize twice, in 1887 and in 1900, and received the degree of Sc.D.h.c. from the University of Michigan in 1913 and the Remington Honor Medal in 1930. Finally, the American Institute of the History of Pharmacy, founded in 1941 on the initiative of Dr. A. H. Uhl in the spirit of Kremers and as an attempt to perpetuate the work and the ideals of this pioneer, made him its honorary president.

On July 6, 1892, Edward Kremers married Miss Laura Haase, of Milwaukee. Of their children three, two daughters and one son, are living, the son, Roland E. Kremers, working with the General Foods Corporation, Hoboken, New Jersey, and a well-known research chemist.

A man of highest merit and achievements as well as of rare human qualities has left this world. In opening to his profession new ways to science and simultaneously giving to science a new group of adepts he not only has enriched but changed the world of his activities.

GEORGE URDANG

AMERICAN INSTITUTE OF THE HISTORY OF PHARMACY

RECENT DEATHS

DR. RUDOLF SCHOENHEIMER, since 1933 assistant professor and since 1939 associate professor of biochemistry at Columbia University, died by suicide on September 11 at the age of forty-three years.

DR. ALLAN CAMERON FRASER, professor of plant breeding at Cornell University, died on Setember 17. He was fifty-one years old.

VELLORA M. FOSTER, a geologist in the U. S. Geological Survey assigned to ground-water investigations in Mississippi, died on September 2 at the age of thirty-seven years.

THE death is announced at the age of sixty-eight years of Dr. E. E. Maar, professor of the history of medicine in the University of Copenhagen.

SCIENTIFIC EVENTS

CHEMISTRY IN COLLEGE-GRADE DEFENSE TRAINING

CHEMISTRY is included in the new program of college-grade defense training of the U. S. Office of Education, which began on July 1. The new program, described in the *News Edition* of the American Chemical Society, called Engineering, Science and Management Defense Training (ESMDT), is successor to the Engineering Defense Training (EDT) of last year. Besides engineering and chemistry, it includes physics and production supervision (industrial management). The appropriation of $17,500,000 for defense training was divided as follows: chemistry and production supervision, $500,000 each; physics, $100,000; engineering, $16,400,000. Chemical engineering is included in engineering, and accordingly some types of chemical courses have been given under the old program, but it has not heretofore been possible to offer chemical courses that could not be classed under engineering—*e.g.*, the training of analysts.

Dr. Austin M. Patterson, who retired in June from administrative and teaching work in Antioch College, has been named senior specialist in chemistry education and becomes a member of the Washington staff. Professor Norris W. Rakestraw, of Brown University, has accepted appointment as a member of the National Advisory Committee to represent chemistry. Dr. Irvin H. Solt, formerly of the University of New Hampshire, will handle physics; Victor S. Karabasz, University of Pennsylvania, is consultant on business management. Dean Homer L. Dodge, of the University of Oklahoma, and Dean Clare E. Griffin, of the University of Michigan, have been appointed members of the National Advisory Committee to represent physics and production supervision.

Dean R. A. Seaton, of the Kansas State College, is director, and Dean George W. Case, of the University of New Hampshire, and Dean Harold M. Crothers, of the South Dakota State College, are the principal specialists in engineering education. Dean A. A. Potter, of Purdue University, is chairman of the National Advisory Committee.

The purpose of the defense training program is to provide, through various universities, colleges and technical schools, short practical courses of college grade to meet the shortage of trained persons in fields essential to the national defense. In most cases these are part-time courses, given in the evening and designed for in-service training, on or off campus, but pre-employment courses are also being given to persons wishing to prepare for a specific job. The Government pays the actual expense of the courses, including teachers' salaries, but the institution contributes its facilities.

The Engineering, Science and Management Defense Training operates through a system of 22 regional advisers, each of whom is chairman of a committee composed of representatives of the participating institutions in that region. It is the duty of these committees to study the needs in their respective regions; the institutions then make detailed proposals of courses to be offered to meet these needs. If these proposals are approved by the Washington office, courses are organized. The courses are not substitutes for the regular ones leading to a degree and are not (with rare exceptions) given for credit.

In the EDT program now nearing completion, more than 100,000 trainees were enrolled in engineering courses. The number of participating institutions was 144, and the estimated cost about $7,500,000.

THE SUBMICROSCOPICAL RESEARCH CENTER AT STANFORD UNIVERSITY

THE Stanford project for the establishment of a submicroscopical research center for which a grant of $65,000 was made by the Rockefeller Foundation can be divided into three main phases of the work:

(1) Construction of a "service" electron microscope embodying some improvements based on the experience with different actually existing instruments. It will be of such a design that all further developments and improvements can be easily adapted to it. This first instrument should be applied to research projects in the various fields of biology, chemistry, physics, metallography, etc., without forgetting the defense applications of the instrument.

(2) Development of the electron microscope and of all the methods used in conjunction for exploring submicroscopical dimensions. This development program calls for improvements in the resolving power of the electron microscope, improvements in the methods applied for the study of various problems, further physical investigation of the conditions of image formation in the electron microscope, development of auxiliary apparatus and development of any such methods or means which may contribute to the knowledge of the dimensions below the limit of visibility of the light microscope.

(3) With the development of electron optics and electron microscopy, there is an increasing demand for specialized personnel in this new field. The third important task of the research center is the education of such specialists.

A NEW BIOLOGICAL LABORATORY IN ALASKA

THE U. S. Fish and Wildlife Service, formerly the Bureau of Fisheries, recently completed the construction of a permanent field laboratory in southeastern Alaska for the study of the natural reproduction of the pink salmon. The laboratory is located at Little Port Walter on the southern tip of Baranof Island, approximately eighteen miles from the open ocean. There is only one stream flowing into the bay at this location. It originates in a series of mountain lakes and is supplied with a continuous flow of well-aerated water at all times. The bed of the stream varies from sand to large rocks, thus providing opportunity to study the suitability of various types of bottom for the spawning and incubation of the salmon. The entire watershed of the stream, which includes an area of five square miles, has been set aside by the U. S. Forest Service for the exclusive use of the Fish and Wildlife Service.

The populations of pink salmon that reproduce in the stream do not enter the commercial fishery to any great extent and practically all the adults returning from the ocean can be accounted for. By tallying the number of adult salmon that enter the stream each season to spawn and the number of fry that migrate from it to the ocean, it is possible to determine the natural mortality of each year's brood, both in the stream and in the ocean.

The experimental set-up at Little Port Walter consists of a permanent concrete weir by means of which the adult salmon are counted into the stream in the fall of each year and the resulting fry are counted as they migrate from the stream in the spring of each year. Continuous year-round observations are being made of variations in the weather conditions and other natural factors that may influence the survival of each year's brood while in the stream. For this purpose a large laboratory and residence building was constructed at this location which includes a small apartment for the resident biologist and living quarters for the crew necessary in the seasonal operation of the weir. Space is also provided in the building for guest investigators and upon completion of the laboratory facilities accommodations will be available for visiting biologists.

F. A. DAVIDSON,
Fish and Wildlife Service

THE USE FOR DEFENSE PURPOSES OF THE BUILDING IN WASHINGTON OF THE NATIONAL ACADEMY OF SCIENCES

DR. FRANK B. JEWETT, president of the National Academy of Sciences, has written a letter to members of the academy which reads as follows:

The purpose of this letter is to advise you concerning developments in the use of the Academy-Research Council Building for scientific work concerned with defense problems.

As you are all doubtless aware the development of the defense program has directed a steadily increasing amount of work to the academy and research council. Present indications are that still further demands will be made on them and their facilities.

In addition to an added burden on the administrative

and operating personnel the most acute problem has been one of space for offices and committee rooms required for a proper carrying on of the work of the academy and research council themselves and of certain scientific work closely associated with that of either the academy or research council.

Early last spring it became necessary to request Science Service to vacate the offices it has occupied for so long and in such pleasant association with the academy and council. Even this move which freed the entire regular office space proved only a temporary solution, however.

By mid-summer overcrowding and further demands were again acute. These demands arose both from the increasing work of the academy and council themselves and also from the needs of two sections in the Office of Scientific Research and Development whose work had to be carried on in close cooperation with the academy and council and in close proximity to the Army and Navy headquarters.

These two sections of the Office of Scientific Research and Development (both headed by members of the academy) are those of the Medical Committee of which Dr. A. N. Richards is chairman and which is intimately associated with the Medical Division of the council, and Section A of the National Defense Research Committee of which Dr. Richard C. Tolman is chairman. The work of this section is directly connected with the work under a contract with the Army of a very active academy committee of which Dr. Tolman is chairman.

Dr. Bush, director of the Office of Scientific Research and Development, made strong formal request for the housing of this and similar work intimately connected with the academy and council in the academy building.

The only possibility of providing this space was the use temporarily of some or all of the rooms now assigned for scientific exhibits. These exhibits are part of the original plan for the building and are a valuable adjunct of the academy and council. At the same time their retention to the detriment of working space urgently needed for defense work was hard to justify.

After a thorough study of the situation the Advisory Committee on Buildings and Grounds has recommended, and the Executive Committee of the Council has approved, temporary utilization of such of the space as may be required for additional offices. The exhibits removed are to be stored and reinstalled as soon as the emergency is over.

THE BRITISH ASSOCIATION

PROFESSOR ALVIN H. HANSEN, of Harvard University, consultant of the Federal Reserve System, and Professor Luther H. Gulick, of Columbia University, consultant of the National Resources Planning Board, left on the Atlantic Clipper on September 18 to attend the International Conference on Science and the World Order which is to be held at the Royal Institution, London, on September 26, 27 and 28.

At successive sessions, speakers representing science in Britain and other countries will deal with the following topics (the international aspects to be stressed throughout): September 26, "Science in Government" and "Science and Human Needs"; September 27, "Science and World Planning" and "Science and Technological Advance"; September 28, "Science and Post-War Relief" and "Science and the World Mind."

John G. Winant, United States Ambassador to Britain, will preside at the session on "Science and Human Needs." H. G. Wells will be chairman at the session on "Science and the Human Mind."

Dr. James Bryant Conant, president of Harvard University, has made a phonographic record, for delivery in London, of his comments on the American set-up of science and government and on Anglo-American policy, and Professor Albert Einstein, of the Institute for Advanced Study at Princeton, has made recordings in German and in English for an address on "The Common Language of Science."

At the conclusion of the meeting, the president, Sir Richard Gregory, will announce a charter of scientific fellowship, which has been drawn up by a committee of the division and adopted by the council of the British Association.

SCIENTIFIC NOTES AND NEWS

THE autumn general meeting of the American Philosophical Society will be held on November 21 and 22, beginning at 10 A.M. on Friday, when there will be "Reports on the Scientific Results of the United States Antarctic Expedition, 1939–41" and on the "Interest of the United States in Polar Lands." In the evening there will be a public lecture followed by a reception. On Saturday morning there will be an open session for the reading of papers and for reports of research that has been aided by grants from the society.

A DINNER in honor of John Dewey was given at the University of Chicago on September 23 as part of the fiftieth anniversary celebration of the University of Chicago. It was followed by the unveiling of the bust of Dr. Dewey, which has been presented to the university through contributions from friends and admirers and the cooperation of Robert Heckert and the generosity of the sculptor, Alexander Portnoff. The bust is to be placed in the Graduate Education Building in commemoration of John Dewey's service at the university.

ACCORDING to the *Journal* of the American Medical Association, Dr. José A. Saralegui, professor of radiology and physical therapy in the Faculty of Medical Sciences of Buenos Aires and director of the

Municipal Institute for Radiology and Physical Therapy, Buenos Aires, was the guest of honor at a dinner at the University Club, Chicago, on July 28. He is visiting the United States at the invitation of the Department of State.

A MEDAL was recently presented to Dr. Maurice Roch by the Société Medicale de Genève on the occasion of the twentieth anniversary of his professorship of clinical medicine at Geneva.

DR. H. A. MORGAN, who in 1938 succeeded Dr. Arthur E. Morgan as chairman of the Board of Directors of the Tennessee Valley Authority, has been succeeded by David E. Lilienthal. Dr. Morgan, who is now seventy-five years old, will take Dr. Lilienthal's post as vice-chairman. Dr. Morgan was Tennessee state entomologist from 1905 to 1919, was dean of the College of Agriculture from 1905 to 1919 and president of the University of Tennessee from 1919 to 1933, when he became a member of the Tennessee Valley Authority.

DR. ANDREW H. WOODS, professor and head of the department of psychiatry at the College of Medicine of the State University of Iowa, and since 1928 medical director of the psychopathic hospital, has retired.

DR. GEORGE D. STODDARD, since 1929 professor of child psychology and director of the Iowa Child Welfare Research Station, dean of the Graduate School of the State University of Iowa, has been elected by the New York State Board of Regents to succeed Dr. Ernest E. Cole as State Commissioner of Education and president of the University of the State of New York. The appointment will become effective on July 1, when Dr. Cole will retire, having reached the statutory age limit of seventy years.

DR. BUEFORD M. GILE has become acting head of the department of agricultural economics of the Louisiana State University, and Joseph G. Richard has been appointed to succeed Dr. R. J. Saville as assistant director of the Agricultural Extension Division. Mr. Richard has been assistant extension horticulturist with the division since 1935. Dr. Saville will devote his time to research in the Agricultural Experiment Stations, with a minimum amount of teaching.

PROMOTIONS at the South Dakota State School of Mines include the following: Professor E. E. Clark to be acting head of the department of electrical engineering; Professor Guy March to be chairman of the department of mathematics, and Dr. Edward L. Tullis to be professor of geology and head of the department. James D. Bump, instructor in geology, has become director of the museum; Gordon A. Beebe has been promoted to an associate professorship of civil engineering. New appointments include: R. L. Kidd, assistant professor of mineral dressing, and E. L. Swanson and C. L. Harbison, instructors in mathematics.

DR. ERNEST LUDLOW BOGART, formerly professor and chairman of the department of economics at the University of Illinois, has been appointed lecturer for the current academic year at the New York University School of Commerce, Accounts and Finance. Dr. Bogart, who was president of the American Economic Association in 1931, will offer a course on the economic history of Europe. This course will include a survey of the evolution of agriculture, history and commerce from ancient to modern times, together with a theoretical analysis of important historical economic problems.

DR. ESTHER M. KILLICK, lecturer in industrial physiology at the London School of Hygiene and Tropical Medicine, has been appointed to succeed Dr. Winfred C. Cullis, who has retired with the title emeritus from the professorship of physiology at the London School of Medicine for Women.

THE Jessie Horton Koessler Fellowship of the Institute of Medicine of Chicago, which carries a stipend of $500, has been awarded for 1941–42 to Dr. Zale A. Yanof, who received his medical degree from Northwestern University in 1937 and his master of science degree in medicine from the University of Chicago in 1941. His work on blood pyruvic acid in heart disease will be carried on in the department of medicine of the University of Chicago.

DR. ROBERT E. WILSON, president of the Pan-American Petroleum and Transport Company of New York, who until August 1 served as petroleum consultant to the Office of Production Management, has been appointed by the Office of Petroleum Coordination a member of the Industrial Refining Committee for the Atlantic Coast.

DR. RICHARD W. NELSON has been appointed chief of the division of forest economics of the Forest Service. He has been acting chief of the division for the past year.

DR. J. A. PINCKARD, associate plant pathologist at the North Carolina Agricultural Experiment Station, has been appointed plant pathologist and head of the department of plant pathology of the Mississippi Agricultural Experiment Station.

DR. CARL C. PFEIFFER, formerly associate professor of pharmacology at Wayne University Medical School, has become associated with Parke, Davis and Company in Detroit, Mich., where he will be at the head of a new section devoted to pharmacological research. Dr. Earl R. Loew, formerly assistant professor of physiology at Wayne University Medical

School, has been appointed research pharmacologist. Both Dr. Pfeiffer and Dr. Loew will continue to lecture at the Medical School.

HARRY MILLER has been appointed head of the chemical section of the Pittsfield Works Laboratory of the General Electric Company. He succeeds R. W. Work, who has joined the staff of the Celanese Corporation of America.

DR. J. ALEJANDRO TÉLLIER has been made Director-General of Health in Bolivia.

Nature reports that by an Order of the Committee of Privy Council, made after consultation with the Medical Research Council and with the president of the Royal Society, E. Rock Carling, senior surgeon to the Westminster Hospital, and Professor S. P. Bedson, professor of bacteriology in the University of London, have been appointed members of the Medical Research Council, in succession to Professor G. E. Gask and Professor W. W. C. Topley, who retire on September 30.

DR. ESMOND R. LONG, director of the Henry Phipps Institute of the University of Pennsylvania, is visiting South America on a travel grant awarded by the U. S. Department of State. He was invited by the Government of Colombia to go to Bogota as adviser on the building of a tuberculosis hospital and was later invited to Panama, Costa Rica and Venezuela to lecture on tuberculosis.

DR. ENRIQUE YALOUR, chief of the dairy division of the Argentine Ministry of Agriculture, is visiting the United States to survey the market for Argentine cheese.

DR. CECIL K. DRINKER, professor of physiology and dean of the School of Public Health of Harvard University, will give the Lane Medical lectures at Stanford University from October 6 to 30. The titles of the lectures will be "Physiological Principles Displayed in the Evolution of the Mammalian Circulation"; "The Blood Capillaries of Mammals"; "The Appearance and Elaboration of the Lymphatic Vessels"; "The Blood, the Tissue Fluid and the Lymph as Illustrated by Certain Experiments upon the Heart and Other Organs" and "Some Lessons for Medicine and Surgery."

DR. SAM Z. LEVINE, professor of pediatrics at the Cornell Medical College, gave the address of welcome to incoming students on September 16. He laid stress on the fact that the goal of medicine is no longer merely the prevention and cure of disease, but "the utilization of all measures to promote the health and fitness of all people."

DR. ARTHUR C. DE GRAFF, Samuel A. Brown professor of therapeutics, was the principal speaker at the opening exercises on September 17 of the New York University College of Medicine.

PROFESSOR OTTO MEYERHOF, of the University of Pennsylvania, formerly of the Kaiser Wilhelm Institute of Physiology at Heidelberg, lectured at Iowa State College on September 19. His subject was "Carbohydrate Metabolism."

UNDER authority of the Executive Committee, notice was given April 23 last, that the 1941 convention of the Association of Land-Grant Colleges and Universities would be held in Washington, D. C., on November 10, 11 and 12. Owing to the congestion which now prevails in Washington and the difficulties under which hotels there are operating, the administrator of the Office of Price Administration and Civilian Supply has requested that conventions be withheld from Washington and that the hotels cancel reservations previously made. In view of this situation, the following change in regard as to the place, dates and headquarters for the convention has been made: The fifty-fifth annual convention of the association will be held in Chicago, on November 10, 11 and 12, 1941; pre-convention dates, November 7 to 9, inclusive. Headquarters will be at the Stevens Hotel.

THE eastern regional headquarters of the U. S. Forest Service has moved from Washington to Philadelphia, in line with the program to decentralize the government's established agencies and to make room in Washington for defense agencies. The new headquarters will be in the Bankers Securities Building, Walnut and Juniper Streets, Philadelphia.

THE Lewis Cass Ledyard, Jr., Fellowship was established in 1939 by a gift from Mrs. Ruth E. Ledyard, wife of the late Lewis Cass Ledyard, Jr., a governor of the New York Hospital. The income, amounting to approximately $4,000 annually, will be awarded to an investigator in the fields of medicine and surgery, or in any closely related field. This amount will be applied as follows: $3,000 as a stipend and, approximately, $1,000 for supplies or expenses of the research. Preference will be given to younger applicants who are graduates in medicine, and who have demonstrated fitness to carry on original research of high order. The research work under this fellowship is to be carried on at the New York Hospital and Cornell University Medical College. The fellowship will be available on July 1 at the beginning of the academic year. Applications for the year 1942–43 should be in the hands of the committee by December 15. It is expected that the award will be made by March 15, 1942. Applications should be addressed to The Committee of the Lewis Cass Ledyard, Jr., Fellowship, The Society of the New York Hospital, 525 East 68th Street, New York, N. Y.

DISCUSSION

THE CURRENT LIST OF MEDICAL LITERATURE

ON January 1st, 1941, volume 1, number 1, of the weekly list of current medical literature appeared, and it is potentially by far the most important index of current literature in any scientific field.[1]

Of course the usual indexing and abstracting media are subject bibliographies, and are useful primarily as lists of the prior literature in given fields: as, for example, the *Quarterly Cumulative Index Medicus,* or *Biological Abstracts.* But, there has not been, until the *Current List of Medical Literature* appeared, an exhaustive, classified index to the current literature in any scientific field.

Certainly, the obvious value of this index, and the ease and economy with which it is issued, will mean the prompt appearance of similar indexes in other scientific fields where it is important to have complete lists of the articles occurring in the journals promptly upon their appearance. For example, the publishers of the present indexes and abstracts covering the fields of aeronautics, agriculture, anthropology, astronomy, biology, botany, chemistry, engineering, entomology, geography, geology, meteorology, natural history, ornithology and zoology could easily issue valuable indexes to the current literature in these fields by processes similar to that used in the preparation and publication of the weekly medical list. For that matter, what scholar, in whatever field, would not be pleased to see a weekly, or biweekly, list of all important articles appearing in the journals in his sphere of interest?

The *Current List* is planeographed on 24 pages, and is prepared from cards made primarily for the compilation of the *Index Catalogue of the Library of the Surgeon General's Office.* The cards, representing about 1,000 titles, are withheld from the regular boxes each week, are classified under the 44 groups listed below, and are copied and the typed slips pasted under the proper headings on large sheets, and photographed for the planeograph process. Thus the cost of issuing the weekly edition of 1,000 copies is only $75.00.

The present expenses are being borne by the Friends of the Army Medical Library, and somewhat more than 400 subscriptions have been entered. Certainly the other 600 needed subscriptions will be forthcoming promptly, or they might very well be if some important corrections are made in the classification of the titles in the *Current List.* It would be most unfortunate to allow this potentially valuable index to lapse. No library with a responsibility in any of the 44 fields covered by the index can be without it, nor can any physician who reads the current literature in his field.

The subjects covered by the index, or, in certain cases, like biology and chemistry, the medical aspects of the subjects, are as follows:

1. Anatomy, Embryology, Morphology
2. Anthropology, Ethnology
3. Bacteriology, Microbiology
4. Biology
5. Cancerology
6. Cardiology
7. Chemistry
8. Dentistry, Stomatology
9. Dietetics, Metabolism
10. Endocrinology
11. Gastroenterology
12. Genetics, Eugenics
13. Gynecology, Obstetrics
14. Histology, Cytology
15. Homeopathy, Osteopathy, etc.
16. Hospital Publications
17. Hygiene, Public Health, Sanitation
18. Immunology, Infectious Diseases
19. Industrial Medicine, Insurance
20. Jurisprudence, Criminology
21. Medical History
22. Medicine, Clinical, Internal
23. Medicine, Laboratory, Diagnosis
24. Medicine, Military and Naval
25. Medicine, Tropical
26. Medicine, Veterinary
27. Neurology, Neurosurgery
28. Ophthalmology, Optics
29. Otorhinolaryngology and Phoniatry
30. Parasitology, Entomology
31. Pathology (general)
32. Pediatrics, Child Welfare
33. Pharmacology, Pharmacy
34. Physiology
35. Psychiatry, Psychology
36. Radiology
37. Societies, Miscellaneous
38. Statistics
39. Surgery
40. Therapeutics
41. Tuberculosis
42. Urology
43. Venereology, Dermatology
44. Zoology

The Army Medical Library receives more than 4,000 journals, about 2,200 of which are indexed in the *Current List.* The indexing includes also monographs,

[1] The *Current List of Medical Literature.* Washington, D. C.: Friends of the Army Medical Library, 1941. Weekly. $5.00 per year.

transactions, proceedings, etc., but not books, which are listed separately in six or eight Supplements per year, and are classified in 44 groups which vary only slightly from those in the *Current List*.

The articles in the periodicals or journals are listed as they appear in the respective journals; that is, the journal itself, or the group of articles in a particular number of the journal, is classified under one of the 44 subjects shown above. This is the quick way to handle the classification, and perhaps it was felt that until more funds were available it was the practical way. But it is too rough a grouping to be serviceable. Unless a way is found to classify the individual titles of the articles, and not the titles of the journals, the *Current List* will fail to accomplish its purpose.

For example, one finds, in volume 1, no. 6, column 218, "An improved method of applying insecticidal dusts" under the heading of Anthropology, Ethnology. Obviously it was intended to place this title under Entomology, but the classifier misread the title of the journal in which the article appears. See also on the same page, "Weltkreig und Bevolkerungspolitik" under Bacteriology, Microbiology. "Vitamin K in obstetrics," in the same number of the index, column 255, is classified under Societies, Miscellaneous, whereas one might have expected to find it under the thirteenth class, or group, Gynecology, Obstetrics, etc., etc. Such carelessness reflects badly upon the excellent classification found in the *Index Catalogue*.

For a list of the journals received by the Army Medical Library, see the booklet issued by the library in September, 1940: "Medicofilm Service of the Army Medical Library; its purposes and plan of operation, together with a list of more than 4,000 abbreviated titles of medical periodicals currently received by this library."

One of the most valuable aspects of the *Current List* is the microfilming service which it offers. Persons and libraries will, of course, use their nearest medical library having a microfilm camera and other adequate equipment to secure copies of desired articles in the journals, having found the articles by means of the *Current List*. But, in many cases, it will be desirable to use Medicofilm Service, which will send 35 mm microfilms at the rate of 30 cents for articles of 30 pages or less, and 10 cents for each additional 10 pages or fraction. This, of course, is a low price, as compared with the charges of some of the other microfilm services. Medicofilm Service does not state in the booklet referred to above whether 16 mm films are available.

Unfortunately, Medicofilm Service states (v. 1, Supplement 1) that as a rule it does not reproduce recent books or theses or parts of books, "because this is an infringement of the Copyright Law." . . . This may or may not be a correct interpretation of the law. Why should it not likewise be an infringement to film copyrighted matter in the journals? Also, microfilm copies do not violate the spirit of the copyright act any more than does an interlibrary loan.

Actually, this problem of copyright and microfilming is unsolved. No one knows the answer, but, meanwhile, the principal microfilm laboratories are proceeding to photograph practically anything desired for scholarly purposes, regardless of date or medium—journal, book, or manuscript. The publishers of the journals and books seem more likely to profit than to suffer by this circulation of selected articles or chapters. One hopes that the Carnegie Corporation's proposed report on this subject, now being prepared by a New York City law firm, will remove any such restraint as that which now limits Medicofilm Service.

The Supplements to the *Current List*, referred to above, are of little value, or, rather, are of much less value than they might be if they were classified lists of important new books in the 44 fields of medicine covered by these Supplements. Indeed, one might well expect the Army Medical Library to produce regular classified and annotated lists of new books in all fields of medicine.

Instead, these Supplements are no more than partial lists of recent accessions by the library, many of which books listed are not even remotely concerned with any aspect of medicine. Only those publications for which author cards have been prepared by the library staff, and only those theses which contain 50 or more pages, are listed. Also, the books and theses may be old or new. Their recent accession is the principal reason, the criterion, for entering them in the list—information which can be of very little interest or usefulness to any one.

But, in their own ingenious way, the friends of the Army Medical Library have stumbled upon the most useful kind of index in the field—a weekly classified list of all titles in the principal medical journals of the world; an index published at less than 10 cents per copy. Except for its weird cataloguing, or classifying—which can easily be corrected, the *Current List* is unique and invaluable, and ought to be followed, as said above, by numerous other similar indexes in the sundry fields of science, and perhaps in other fields of current literature; as the social sciences and the humanities, for example.

JOE HARE

UNIVERSITY OF DENVER

YOUNG SAILFISH

A STUDY of young Pacific sailfish, *Istiophorus greyi*, has been completed, dealing with individuals which I took alive on the Eastern Pacific Zaca Expedition (1937–1938) of the New York Zoological Society.

Both were netted at night lights, one of 84 mm standard length, off Mexico on the night of November 23, 1937, and the other, only 42 mm in length, 1,200 miles farther south, off Costa Rica, on March 1, 1938. These have been compared with equally young Florida sailfish, *Istiophorus americanus,* and with adults of both species.

The study is based on observation of the living and recently dead fish, and on normally preserved as well as stained and cleared specimens. It will appear in a forthcoming number of *Zoologica,* the scientific publication of the Zoological Society.

An interesting feature of the young sailfish, evident at first glance, is that in spite of their diminutive size, they are superficially very much like the full-grown fish. The greatly elongated upper jaw and pelvic fins, the enormous expanse of dorsal fin are as characteristic of the 42 mm specimen as they are of the adult, more than 60 times as long.

When, however, there is added to these externals of the normal, opaque fish, the skeleton and other internal structures, there is found little or no hint of the radical changes to come. These young fish are well balanced, efficiently functioning organisms in their own right. Like most fish they are covered with scales, their jaws are filled with teeth of ordinary pattern, and their two specialized fins seem to impose no unusual activities or habits.

There is no suggestion of the subsequent disappearance of the armor of scales, and their replacement with minute, mucous-canal guards and bony scutes. Without ever having seen the full-grown fish, one would never know that the teeth would all fall out, with the substitution of innumerable sharp and strong dermal denticles covering the whole sword.

The entire head and body will undergo vital changes, together with this radical alteration in the dental armature of the snout, and the consequent shift from a prehensile snapping to a slashing method of attack and feeding. A mobile, twisting body will alter to a stiffened, recoil-guarded handle to the great sword; the parethmoid and other regions of the skull, the vertebrae and caudal complex, the fin bases, the pectoral arch—all will witness an ontologically swift and thorough thickening and extension of ossification. All joints will be stiffened until the whole becomes a taut, tense spring, an organic engine to generate and direct the terrific ramming, hitting and slashing power of the solidly denticled sword.

In the young fish all this excess of bone formation is held in abeyance, adumbrated only, so that the toothed, scaled, prehensile stage of development may function as perfectly as though it would persist throughout the entire lifetime of the fish.

WILLIAM BEEBE

NEW YORK ZOOLOGICAL PARK

A SUBMERGED MIGRATION ROUTE

BOTANISTS and others have been interested in the presence of southern plants in southeastern Canada and New England. Explanations involve the possibility of a former pathway of migration along the coast, now submerged.

Recently, through the kindness of Mr. George B. Sowers, of Cleveland, the Oberlin Botanical Laboratory has had the opportunity to study two specimens of peat obtained by a contractor working at the Brooklyn Navy Yard. One specimen, an ooze peat deposited under water, was reported to come from 60 feet below the present water-level; the other, a fibrous superficial peat, from a depth of about 40 feet below the present surface. The lowest deposit is described as being overlaid by gravel and underlaid by about 60 feet of clay resting on bed rock. The deposit is said to be continuous and quite extensive along Long Island. Because the samples were obtained in the course of commercial construction work, some difficulty has been experienced in getting the precise relationship of the two specimens examined.

Both, however, have essentially similar pollen spectrums in which deciduous forest pollen predominates, particularly oak and beech. This indicates quite clearly that at the time the peat was formed, deciduous forest conditions prevailed on the then exposed but now submerged surface, presumably affording an opportunity for the northward migration of plants appropriate to deciduous forest conditions.

The pollen examined appears to be slightly less fresh than that in most post-Wisconsin bogs that I have examined but is well preserved. Hickory is present in the lower sample but absent in the upper. Grass and composites are more abundant in the lower; pine more abundant in the upper one and hemlock is present. No hemlock has been found in the lower specimen. This would suggest that the lower specimen was deposited under somewhat more continental conditions than the upper if our information is correct as to the relative depths. Publication of the spectra will be made after further efforts to secure more precise information regarding the stratigraphy.

PAUL B. SEARS

OBERLIN COLLEGE

THE RELATIONSHIP OF THE AMERICAN PHARMACEUTICAL ASSOCIATION TO THE UNITED STATES PHARMACOPOEIA

SCIENCE for June 20 contains, on page 597, a review by Dr. Charles A. Kofoid of "History of Pharmacy" by Edward Kremers and George Urdang. In this review the following statement is made: "The seventh edition (1862) [of the United States Pharmacopoeia] was the first to be issued under the direct auspices of the American Pharmaceutical Association.

"This statement contains one misprint (1862 instead of 1882) and one misunderstanding. As pointed out in the Kremers-Urdang History the edition of 1882 was prepared under the dominant influence of the American Pharmaceutical Association, and the authors state on several occasions that American professional pharmacy, represented by the American Pharmaceutical Association, took over the patronage and became the guardian of the pharmacopoeial revision work. There is, however, nowhere said that at any time any edition 'was to be issued under the direct auspices of the American Pharmaceutical Association'.

"The issuance of the U.S.P. was prompted first 'By the Authority of the Medical Societies and Colleges' (1820), then 'By the Authority of the General Convention for the Foundation of the American Pharmacopoeia' (New York, 1830) and 'By the Authority of the National Medical Convention' (Philadelphia, 1831). Due to the official participation of representatives of pharmacy in the convention since 1850 the 'Medical' was dropped and it was 'By the Authority of the National Convention for Revising the Pharmacopoeia' that the U.S.P. was issued from 1864 to 1893 (5th to 8th edition). From 1905, *i.e.*, the 9th edition, finally the U.S.P. has been published by the Authority of the United States Pharmacopoeial Convention."

The official publication of the U.S.P. by the American Pharmaceutical Association as such would not have accorded with the urgent desire the association has had and evidenced at all times to make the U.S.P. the common work of American medicine and pharmacy. The growing active interest taken by official American medicine, represented by the American Medical Association, in the pharmacopoeial revision work has been by no one more welcomed by the American Pharmaceutical Association.

It is of especial historical interest that this voluntary undertaking of one hundred twenty years ago should have continued to eventually become recognized as legal standards by both state and national governments, including several of the Pan American republics. There are probably very few other instances of as long standing where professions have voluntarily chosen to submit themselves to such self-regulation and standardization, possible only under a free system of government.

GEO. D. BEAL,
Assistant Director
MELLON INSTITUTE OF INDUSTRIAL RESEARCH

QUOTATIONS

THE MATHEMATICAL TOOL

THERE can be a bottleneck in mathematics just as surely as in machine tools. And to avoid it requires just as careful a program of long-range preparation. The War Preparedness Committee of the American Mathematical Society and the Mathematical Association of America is right in proposing that grade-school boys of 11 and 12 who have mathematical aptitudes be sought out and encouraged to take courses that will lay the foundation for careers in engineering, physics or directly in the technical branches of the armed forces.

The kind of training here needed is not the kind emphasized in certain New York City high schools which make such a fetish of accurate arithmetic that 100 per cent. is the only passing grade. Such a system may turn out some trustworthy bookkeepers, but it will not develop men with mathematical imagination, men who can use mathematics as a tool to shape out the approximations and compromises that are actually involved in engineering design.

The youthful mind, naturally imaginative, is riper than most pedagogues seem to think for symbols and instruments that offer interesting short-cuts through the drudgery of the multiplication table. The accountant doesn't add or multiply by hand—he leaves it to the calculating machine. The engineer doesn't fill a page with figures to extract a square root—he reads it from a slide-rule.

Thornton C. Fry, mathematical research director of the Bell Telephone Laboratories, estimates in a new survey of industrial mathematics that in the design of a modern four-engined transport plane about 100,000 hours are spent on mathematical analysis of structures, performance, lift distribution and stability. In calculations of such magnitude short-cuts and approximations are worth money—they may save thousands of hours. Such work, and similar calculations called for in electric power, communications and petroleum prospecting, must be directed by men who have got beyond the bugbears of arithmetic and are not afraid to look a differential equation in the face.

Probably a majority of the people are afraid of mathematics, and that awe is largely traceable to the early, teacher-inspired worry about not getting the example exactly right. Mathematics could be made a fascinating game. The pupil should be encouraged to approximate, or guess, the answer the minute the problem is put before him; then work it out the regular way and see how close he came; and finally check it with a slide-rule or calculating machine. That—skipping the middle stage of all-out arithmetic—is the way the engineer does it.—*The New York Times.*

SCIENTIFIC BOOKS

PHYSICS AND PHILOSOPHY

Between Physics and Philosophy. By PHILIPP FRANK, visiting lecturer, Harvard University. 238 pp. Cambridge, Mass.: Harvard University Press; London: Humphrey Milford; Oxford University Press. 1941. $2.75.

THE book comprises a series of articles written for the most part during the last ten years. The writer describes the situation to-day as one in which, after the reign of materialism and naturalism in the nineteenth century, our twentieth century shows a trend away from these movements, and in which the emphasis on the irrational and on metaphysics, the idealistic and spiritualistic interpretation of nature and history are recognized more and more as the prominent features of the century. The author cites the principal aim of his essays as an endeavor to show that one can make use of the recent progress of the physical sciences to the end of supporting the twentieth century trend only if one interprets it according to the pattern of some cherished philosophy, disregarding the scientific meaning of modern physics. A second aim of the book is to make a contribution to the history of the development of "logical empiricism."

The essays center around the development in thought initiated by the "Vienna Circle," which formed about 1910, of which the author was one of the founders, and which sought a stand on which the essential points of Mach's positivism, and especially his stand against the use of metaphysics in science, were retained, while a reconstruction of his doctrines where they stood in opposition to the present course of development of science was attempted.

Following an Introduction in the form of a historical background, the essays comprise the following:

I. The Law of Causality and Experience (1908)
II. The Importance of Ernst Mach's Philosophy of Science for our Times (1917)
III. Physical Theories of the Twentieth Century and School Philosophy (1929)
IV. Is There a Trend To-day Toward Idealism in Physics? (1934)
V. The Positivistic and The Metaphysical Conception of Physics (1935)
VI. Logical Empiricism and the Philosophy of the Soviet Union (1935)
VII. Philosophical Misinterpretations of the Quantum Theory (1936)
VIII. What "Length" means to the Physicist (1937)
IX. Determinism and Indeterminism in Modern Physics (1938)
X. Ernst Mach and the Unity of Science (1938)

It is naturally impossible here to attempt anything of the nature of an exhaustive review of the contents of such a broad scheme of essays. In all of them, however, it is refreshing to find an author talking a language which can form the common ground of the physicist and the philosopher. For these two groups are frequently suspicious of each other, and the former often feels that the latter, having developed his concepts to a point where they cry for more precise meaning that they may take some action in the world, proceeds at this stage to group them into categories and give them names. A name covers a multitude of sins and shrouds its charges with a kind of veil in which they somehow or other seek to claim that all would be clear with regard to them if one had a more precise knowledge of the meaning of the dictionary. And so, even in Professor Frank's book, the physicist is inclined to shudder at so many "isms," but he is happy to find the author shuddering in some degree with him, and prepared occasionally to sympathize with even those whom the strict theoretical physicist must regard as materialistic sinners in his clan. Thus, in contrasting the direct and bold procedure of the practical scientific investigator with the doctrines of the less practical, but critical analysts of the meaning of things, the author very neatly defines the true function of the latter in the words: "My view is that their main value is not that they help the physicist to go forward in his physical work, but rather that they provide the means for defending the edifice of physics against attacks from outside."

In these days, when so much is said about the overthrow of mechanistic principles, it is very refreshing to read such phrases as:

> If we say, however, that the mechanical foundation has been replaced by a mathematical one (speaking of relativity and quantum theory), it is, in my opinion, a very inappropriate mode of expression. We ought to say, rather, that the place of a special mathematical theory, that of Newton, has been taken by more general theories, the relativity and quantum theories.

In conclusion, in collecting these essays into book form, Professor Frank is to be congratulated upon producing a work which will be of distinct value to the physicist and the philosopher alike, and one which should broaden considerably the common realms of understanding of these two fields of knowledge.

W. F. G. SWANN
BARTOL RESEARCH FOUNDATION
OF THE FRANKLIN INSTITUTE,
SWARTHMORE, PA.

A BACKGROUND TO MUSEUM EXHIBITION

By Their Works. By H. PHELPS CLAWSON. 260 pp. 107 illustrations. Buffalo, N. Y.: Buffalo Society of Natural Sciences. 1941. $4.00.

"BY THEIR WORKS" is an interesting and important addition to the growing literature of that nascent social science, museology. The purpose of the volume is to create a historical and cultural setting for an exhibition of anonymous art, drawn from all epochs and all quarters of the globe, on view at the Buffalo Museum of Science. It provides a framework on which to hang an appreciation of the arts of the European Stone and Iron ages, Egypt, the Near East, China, Greece, Indonesia, Australia, Oceania, the Americas, Africa, Luristan, Ordos and the Syro-Hittites. The volume is copiously illustrated, an important feature, since the educated public is more used to two-dimensional visualization in terms of the printed page than to direct appreciation of an object in its three-dimensional reality.

The text is really subordinate to the pictures, or rather to the specimens which they illustrate. There is no need to cavil at Mr. Clawson for handling his material in this way, since an exhibition speaks for itself and lush verbalization is unnecessary. The examples are on the whole well-chosen and there is a feeling of balance and continuity in the quality of the display. A person who has major interests in any one art field might bawl and scream that some of his pet pieces were left out. The reason many of these finer examples are lacking is that the book is designed to cover only the material available in the Buffalo Museum. Thus "By Their Works" fully achieves its basic purpose.

Mr. Clawson has provided a point of reference to the exhibitions which can not be attained through the medium of labels. He has sketched in the social history of the makers of the objects in the display and given the serious visitor a means of preparation for what he is about to see, and a method of conserving the memory of what he has already contemplated. How many museums can claim to have done the same for their clientèle?

GEORGE C. VAILLANT
THE AMERICAN MUSEUM OF NATURAL HISTORY

REPORTS

THE PROPOSED SOCIETY FOR FREEDOM IN SCIENCE

(1) IT is generally agreed that if totalitarian dictators were successful in the present war, they would ultimately put an end to the freedom of scientific research throughout the world. Their pronouncements and their practice alike can leave no doubt upon the point. Defense of scientific freedom, equally with other freedoms, is therefore an integral part of the struggle.

(2) The threat to scientific freedom comes not only from existing dictatorships. Great social changes are inevitable after the conclusion of peace, and some of the changes now ardently advocated in democratic countries contain a definite threat to scientific freedom. There is a widespread and vigorous movement which sees the solution of social difficulties in a complete recasting of the structure of society under a system of central control. Thus there is a threat to scientific freedom, less direct though perhaps as dangerous, from some of the adherents to the doctrine of "central planning."

(3) Science has a value which is independent of the practical benefits it yields to society. The methods of science, its heritage of knowledge and the scientific habit of thought together constitute a scientific culture which must be recognized as being on a par with the artistic and literary cultures; and freedom is essential for all alike. Without freedom science can not flourish, and therefore can not serve the cultural and practical needs of society.

(4) The threat to freedom in science is believed to be real and dangerous because of the enthusiasm which can be evoked by the doctrine of central planning in the supposed interests of the community. Those who would apply this doctrine to almost every detail of social life represent a school of thought which makes a strong appeal to many of the more active-minded and socially conscious scientists. It seems to be clear that many of the adherents of planning are unaware of the decisive limitations implied by their aims to the freedom and progress of science. Others appear to minimize or to disregard these dangers in their determination to follow the aims of general social planning, whatever its consequences in the province of science.

(5) The vindication of scientific independence is not a doctrine of social indifference but is on the contrary a positive assertion of rights and duties. One of the principal social duties of the scientist is the defense of scientific freedom, for he knows how essential that freedom is for scientific discovery and for the origin of those practical benefits to society which are the natural by-products of his work. At the same time he must recognize the need for continuous reform both in the life of scientific institutions and in the fields where science impinges on society. Almost every professional scientist has some duties apart from pure research: he may undertake teaching, ad-

ministration of a research institution, medical practice, industrial consultation, etc. In fulfilling these duties the scientist should be guided by a realization of their wider social implications and should steadily help to make society more humane, juster and more efficient. Scientists who are prepared to fight for freedom in science are as eager as any one to make contributions to social progress.

(6) In order to maintain scientific freedom in the countries where it still happily exists and to assist in its reestablishment in regions where it is now suppressed, it seems necessary to organize the forces which support the ideal of free science. It is desired to clarify and formulate the ideas involved in the phrase "freedom in science" and to help to support those institutions which now maintain this freedom. If this can be done successfully, a real contribution will be made to the general advance of freedom to which military victory will open the path and which alone can make that victory effective.

(7) The aim of the existing scientific societies as reflected in their publications is almost entirely the direct promotion of research: the independence of science is taken for granted. The Society for Freedom of Science, conscious that this independence is threatened, would work to frustrate the threat.

(8) A nucleus of members has already been secured and it is now desired to build up a large body of scientists, mainly active research workers, who subscribe to the following propositions:

(i) The increase of knowledge by scientific research of all kinds and the maintenance and spread of scientific culture have an independent and primary human value.

(ii) Science can only flourish and therefore can only confer the maximum cultural and practical benefits on society when research is conducted in an atmosphere of freedom.

(iii) Scientific life should be autonomous and not subject to outside control in the appointment of personnel or in the allocation of the funds assigned by society to science.

(iv) The conditions of appointment of research workers at universities should give them freedom to choose their own problems within their subjects and to work separately or in collaboration as they may prefer. Controlled teamwork, essential for some problems, is out of place in others. Some people work best singly, others in teams, and provision should be made for both types.

(v) Scientists in countries not under dictatorial rule should cooperate to maintain the freedom necessary for effective work and to help fellow-scientists in all parts of the world to maintain or secure this freedom.

(9) Membership of the society involves nothing beyond the support—if necessary the active support—of these principles. It is not proposed, in the first instance at least, to ask for a subscription, though some of the original adherents have contributed money to defray the necessary costs of copying and postage, and such donations are welcome. There is at present a small provisional committee, but it is entirely informal and will resign when the society is sufficiently organized to permit of an election. The present statement has been drawn up by the provisional committee, which is also actively contemplating the publication of a book of essays by several members of the society dealing with various aspects of freedom in science.

(10) Dr. John R. Baker, University Museum, Oxford, to whom the society owes its inception, is acting as secretary. Notices of adherence should be sent to him with any suggestions as to the policy of the society.

SPECIAL ARTICLES

WESTERN EQUINE AND ST. LOUIS ENCEPHALITIS ANTIBODIES IN THE SERA OF MAMMALS AND BIRDS FROM AN ENDEMIC AREA[1]

THE virus of Western equine encephalomyelitis has never been isolated from naturally infected mammals or birds, except man, horses and mules, although attempted by several workers. Howitt[2] noted the presence of antibodies to this virus in a few chickens and one quail. Hammon and Howitt[3] and Hammon[4] noted the presence of antibodies in 5 of 9 chickens, 1 domestic duck and 1 of 3 pheasants in an endemic area. The virus of St. Louis encephalitis has been isolated only from man, but neutralizing antibodies were found in horses during the summer of 1940 by Philip, Cox and Fountain,[5] by Howitt and Van Herick[6] and by Hammon and Howitt,[3] and their specificity confirmed and the susceptibility of the horse demonstrated, as a sequel to these findings by Cox, Philip and Kilpatrick.[7] Howitt and Van Herick[6] also found antibodies for this virus in the blood of certain domestic fowl in California.

In the Yakima Valley, Washington, in 1940, evi-

[1] From a Cooperative Survey of Encephalitis in the Yakima Valley by the University of California, the State College of Washington, the Washington State Health Department, the Yakima City-County Health Department and the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine. Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

[2] B. F. Howitt, *Jour. Infect. Dis.*, 67: 177, 1940.

[3] W. McD. Hammon and B. F. Howitt, to be published.

[4] W. McD. Hammon, *Jour. Am. Med. Asn.*, 117: 161, 1941.

[5] C. B. Philip, H. R. Cox and J. H. Fountain, *Pub. Health Rep.*, 56: 1388, 1941.

[6] B. F. Howitt and W. Van Herick. In press.

[7] H. R. Cox, C. B. Philip and J. W. Kilpatrick, *Pub. Health Rep.*, 56: 1391, 1941.

dence was obtained indicating the probable presence of both the Western equine virus and the St. Louis virus[8] in annual epidemics in man and horses (Hammon,[4] Hammon and Howitt[3]). This is a preliminary report of part of an extensive survey of the same region, started in May, 1941, and continuing during the epidemic of that year, in which the sera from mammals and birds, both domestic and wild, have been tested for the presence of neutralizing antibodies to both of these viruses, and to certain others to be reported later. Word now reaching us of extensive encephalitis outbreaks elsewhere in the West prompted the release of this report while the work was still in progress.

This approach through the neutralization test has proved useful in the study of jungle yellow fever reservoirs, and it seemed likely that as a preliminary survey it would yield more information regarding the extent of infection and possible reservoirs than a search for the actual viruses, since infection has never been manifested by any observed epizootic except in horses, thus differing from the Eastern equine virus.

Bloods were taken with aseptic technique, the serum separated in the field laboratory and shipped in CO_2 ice to the San Francisco laboratory. Tests for antibodies were made by using a carefully pretitrated, stable virus suspension, which was frozen and stored in ampoules at −76 degrees C. The standardized intracerebral technique employed has been described by Hammon and Izumi.[9] A positive for the Western equine virus indicated an ability of the serum tested to protect all mice against at least 10 times the greatest quantity of virus which would permit similar survival in the presence of a negative serum under identical conditions of time, temperature and serum concentration. Similarly, a positive for the St. Louis virus indicated protection against at least a 33-fold increase in virus. Many sera protected against a still greater virus concentration. Positive findings were confirmed by retesting, except in a few instances where the amount of serum available was insufficient. Sera which repeatedly protected only 2 of 4 mice in the higher virus dilution have been classified as questionable and have been omitted from the tabulated data. To date, the sera of 162 birds and 153 mammals have been tested against the St. Louis virus, and of 172 birds and 161 mammals against the equine virus. Those yielding clear-cut results are shown in Tables 1 and 2. No classification other than the categories of "domestic" and "wild" has been attempted.

Before these positive neutralizations may all be accepted as significant, *i.e.*, the virucidal properties demonstrated to be specific, much further work must be done. We have already studied control series, with significantly different findings in respect to both viruses for horses and cows from Massachusetts, Texas, Arizona and Nevada. Howitt[2] has done the same in California for chickens, turkeys, ducks, pigeons and quail with the equine virus, and for chickens with the St. Louis virus.[6] We have just completed tests with the equine virus on sera of 11 pigeons from Iowa and New York without finding any positives. Controls on a number of other species are being tested. Antibody response to virus inoculation has been demonstrated in the horse for the St. Louis virus (Cox, Philip and Kilpatrick[7]) and for the above-mentioned fowl and certain other birds for the Western equine virus, by Howitt.[2] It would seem probable, therefore, that the antibodies found in many of the species listed in the table are the result of specific infection, probably of a mild or inapparent nature.

It will be noted that for the St. Louis virus, 50.0 per cent. of 70 domestic birds showed protection, as

TABLE 1

NEUTRALIZATION TESTS ON SERUM OF BIRDS

	St. Louis Neg.	St. Louis Pos.	W. Equine Neg.	W. Equine Pos.
Domestic or in Captivity:				
Chicken (*Gallus domesticus*)	14	3	14	4
Duck, Common Mallard (*Anas platyrhynchos*)	4	1	3	3
Duck, Pekin (*Anas platyrhynchos*)	1	6	3	5
Goose, Domestic (*Anser anser*)	3	7	4	6
Owl, Great Horned (*Bubo virginianus*)	0	3	0	3
Pigeon, Domestic (*Columba livia*)	4	7	5	5
Turkey (*Meleagris gallopavo*)	3	3	3	5
*Miscellaneous	6	5	6	5
Total domestic	35	35	38	36
Wild:				
Blackbird, Brewer (*Euphagus cyanocephalus*)	19	0	14	0
Dove, Western Mourning (*Zenaidura macroura*)	2	3	6	0
Flicker, Red-shafted (*Colaptes cafer*)	1	1	3	1
Hawk, Sparrow (*Falco sparverius*)	2	1	1	2
Killdeer (*Oxyechus vociferus*)	9	0	5	3
Pheasant, Ring-necked (*Phasianus colchicus*)	4	0	3	2
Quail, California (*Lophortyx californica*)	6	3	6	3
Robin (*Turdus migratorius*)	4	3	4	5
Sparrow, English (*Passer domesticus*)	11	0	8	0
Woodpecker, Lewis (*Asyndesmus lewis*)	3	0	3	0
*Miscellaneous	13	2	11	0
Total wild	74	13	64	16
Total	109	48	102	52

* Only one or two examined of each species.

[8] Since writing this, Hammon, Reeves, Brookman, Izumi and Gjullin have isolated the St. Louis virus from mosquitoes of this same area, thus definitely proving its presence (to be published).

[9] W. McD. Hammon and E. M. Izumi, to be published.

TABLE 2

NEUTRALIZATION TESTS ON SERUM OF MAMMALS

	St. Louis Neg.	St. Louis Pos.	W. Equine Neg.	W. Equine Pos.
Domestic or in Captivity:				
Cat, House (*Felis domesticus*)	8	0	8	0
Cow (*Bos taurus*)	10	6	9	5
Dog (*Canis familiaris*)	8	3	6	2
Goat, Domestic (*Capra hircus*)	3	3	3	3
Horse (*Equus caballus*)	0	12	0[T]	9[T]
Pig (*Sus scrofa*)	3	1	3	1
Sheep, Domestic (*Ovis aries*)	8	2	10	1
*Miscellaneous	8	2	9	2
Total Domestic	48	29	48	23
Wild:				
Chipmunk. Great Basin (*Eutamias minimus*)	5	0	6	0
Ground Squirrel. Townsend (*Citellus townsendii*)	11	0	12	0
Mouse, Field (*Microtus montanus*)	8	0	8	1
Mouse, White-footed (*Peromyscus maniculatus*)	2	0	4	1
Pocket Gopher (*Thomomys talpoides*)	5	0	4	0
Rabbit, Cottontail (*Sylvilagus nuttalli*)	7	1	9	0
Rabbit, Jack (*Lepus californicus*)	5	1	10	0
Rat, Brown (*Rattus norvegicus*)	4	3	10	0
Rat, Black (*Rattus rattus*)	4	1	5	0
Weasel (*Mustela frenata*)	4	0	3	2
*Miscellaneous	4	0	3	0
Total Wild	59	6	74	4
Total	107	35	122	27

* Only one or two examined of each species.
[T] Not vaccinated for Western equine encephalomyelitis.

against 15.0 per cent. of 87 wild; and for the equine virus the respective percentages are 48.7 per cent. of 74 and 20.0 per cent. of 80. Of 77 domestic mammals tested, 37.7 per cent. protected against the St. Louis virus in contrast to 9.2 per cent. of 65 wild, and for the equine virus 32.4 per cent. of 71 domestic as against 5.1 per cent. of 78 wild. Caution is suggested in interpretation of these differences between the domestic and wild animal groups until both the areas of sampling and the species sampling can be more carefully analyzed. However, both the domestic and wild species were collected principally in areas where cases of encephalitis had occurred in 1939, 1940 or 1941. The only species of which an overly large sample was taken, which might exaggerate the above difference, is the Brewer blackbird.

If the apparent significance of these findings is confirmed, it will indicate a much more wide-spread potential reservoir for both viruses than has generally been suspected, especially for the St. Louis virus. It would appear that barnyards and fowl runs, found in large numbers in small towns, rural and suburban areas, are the principal foci of infection for encephalitis of either the Western equine or the St. Louis type. The distribution of human and obviously of horse cases has conformed with this pattern.[4, 10, 3] Final results, together with other aspects of the survey and with more adequate discussion of the potentialities of the findings, will be published following completion of the survey.

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WILLIAM MCD. HAMMON
JOHN A. GRAY, JR.
FRANCIS C. EVANS
ERNEST M. IZUMI
GEORGE WILLIAMS HOOPER FOUNDATION,
UNIVERSITY OF CALIFORNIA, SAN FRANCISCO
HOWARD W. LUNDY
DEPARTMENT OF BACTERIOLOGY AND PUBLIC HEALTH,
STATE COLLEGE OF WASHINGTON, PULLMAN

A SYNDROME IN MACACUS RHESUS AFTER INOCULATION OF STOOL FROM CARRIERS OF POLIOMYELITIS VIRUS[1, 2]

DURING a study of stool specimens from contacts and patients in an outbreak of infantile paralysis in a rural community, certain monkeys (*Macacus rhesus*) that failed to develop anterior poliomyelitis nevertheless showed signs of disease. The clinical symptoms ordinarily appeared from the tenth to the fifteenth day after inoculation. They consisted of some change in behavior, that is, lethargy or excitement, diarrhea and loss of appetite, associated with a slight febrile temperature lasting from twenty-four to forty-eight hours. After it became apparent that such mild illness followed stool inoculation and that the incubation period compared closely with that in monkeys developing poliomyelitis, all animals were killed and autopsied after the twenty-first day following inoculation.

Tissue was taken from the following regions of the

[10] *Public Health Bulletin*, No. 214, 1935.
[1] A preliminary report.
[2] Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

central nervous system: the intervertebral ganglia; the sympathetic chains; the ganglia of both vagus nerves external to the skull; the Gasserian ganglia; the olfactory bulbs; the sacral, lumbar, upper and lower dorsal, and cervical regions of the spinal cord; from the medulla; the mesencephalon; the diencephalon, and from each of the major lobes of the cerebral cortex of both hemispheres of the brain, as well as from the cerebellum, including the roof nuclei. These tissues were fixed immediately in 70-per-cent. alcohol and the sections eventually stained with thionin.

It was observed that lesions resembling those ordinarily found in the intervertebral ganglia in cases of typical anterior poliomyelitis were also present in the intervertebral ganglia of most of these monkeys. Moreover, similar lesions were almost invariably present in the large-celled portion of one or both vagus ganglia and, rarely, in one or both Gasserian ganglia. The lesions varied from extremely mild, doubtful ones to florid pathologic changes. They consisted of focal interstitial ganglionitis, with focal destruction of neurons and neuronophagia. Some degree of perivascular "cuffing" was usually present. The exudative cells were predominantly mononuclear types. These lesions followed intraperitoneal inoculation of treated stool from patients with clinical anterior poliomyelitis or from contacts. If, in addition to the intraperitoneal route, stool was exhibited to monkeys intranasally, then lesions of the olfactory bulbs sometimes occurred. In the olfactory bulbs, the lesions consisted of perivascular "collaring" with foci of cell necrosis and exudative accumulations principally in the mitral-cell layer. Degeneration of mitral cells had occurred, and although neuronophagia was not always easy to identify in the manner that one does in anterior-horn cells, evidence of it appeared to be present. No changes were noted in sections that were studied from the remainder of the central nervous system of these animals.

In the seven instances in which this syndrome was observed, other monkeys were subsequently inoculated with larger doses of the original stool specimens. In five of the seven, a monkey eventually contracted classical anterior poliomyelitis. Sometimes as many as four attempts in as many monkeys, with repeated occurrence of the mild disease described, were necessary to achieve, in one monkey, the accepted endpoint, that is, fever, flaccid paralysis and anterior-horn cell necrosis with neuronophagia and perivascular "cuffing." In one case, stool inoculation, intranasally and intraperitoneally, was made in two different monkeys. Although neither developed typical poliomyelitis, both showed lesions in the vagus and spinal ganglia and in the olfactory bulbs. The patient from whom this specimen of feces was obtained had clinical poliomyelitis. In the seventh instance, no illness and no lesions were obtained after the inoculation was repeated.

It is common knowledge that a characteristic pathologic picture may be found in intervertebral ganglia and olfactory bulbs in experimental and human anterior poliomyelitis. That similar changes may be present in the ganglia of the vagus nerves is not usually recognized. It may be opportune at this point to call attention to a publication of Goodpasture in 1925,[3] in which, after studying tissue obtained at autopsy from a patient with "polio-encephalomyelitis," he makes the following statement: "A case of polioencephalomyelitis in a boy is described in which medullary lesions were found which appear to be directly related to the central distribution of the ninth and tenth cranial nerves. It is suggested that the virus of poliomyelitis in human infections may enter the brain through peripheral nerves."

Further work is in progress to determine whether or not the syndrome described is truly atypical anterior poliomyelitis, and what possible significance lesions of the vagal ganglia may have. However, these observations demonstrate the necessity of killing and examining all inoculated monkeys.

SUMMARY

A mild clinical syndrome in *Macacus rhesus*, accompanied by pathologic changes in the sensory portions of the vagus ganglia, intervertebral ganglia, and sometimes in the Gasserian ganglia is described. This syndrome occurred following intraperitoneal inoculation of fecal material obtained from contacts and from patients with infantile paralysis in an epidemic in a rural community. When intranasal as well as intraperitoneal inoculation was practiced, the olfactory bulbs were sometimes involved.

GEORGE Y. MCCLURE

DIVISION OF LABORATORIES AND RESEARCH,
NEW YORK STATE DEPARTMENT
OF HEALTH, ALBANY

RESYNTHESIS OF BIOTIN FROM A DEGRADATION PRODUCT[1]

IN a forthcoming paper[2] we are presenting data which indicate that biotin ($C_{10}H_{16}O_3N_2S$) is a cyclic urea derivative. The basis of this conclusion was the formation of a diaminocarboxylic acid ($C_9H_{18}O_2N_2S$) from biotin by the action of $Ba(OH)_2$ at 140°. The loss of one carbon atom and one oxygen atom, the

[3] E. W. Goodpasture, *Amer. Jour. Path.*, 1: 29–46, 1925.

[1] We wish to thank Mr. W. O. Frohring, of the SMA Corporation, for supplies of biotin concentrates used by us in the preparation of the crystalline biotin and for a research grant which has aided us in this work.

[2] K. Hofmann, D. B. Melville and V. du Vigneaud, *Jour. Biol. Chem.*, 141: 207, 1941.

formation of an acid containing two primary amino groups from the acidic biotin, the inactivation of biotin with nitrous acid without evolution of nitrogen are all in keeping with the interpretation which we placed on the action of $Ba(OH)_2$ on biotin. We should now like to report the resynthesis of biotin from this diaminocarboxylic acid.

If our interpretation of the degradation reaction were correct, it should be possible to convert the diaminocarboxylic acid back to biotin through reactions employed for the synthesis of urea derivatives. Accordingly 10 mg of the diaminocarboxylic acid were treated with phosgene under conditions ordinarily employed. Crystalline biotin was obtained from the reaction mixture in 98 per cent. yield. The compound melted at 228–230° (uncorrected), which agrees with that recorded by us for natural biotin.[3] The melting point of a mixture of the synthetic compound with biotin isolated from natural sources showed no depression. The specific rotation of the resynthesized biotin was $[\alpha]_D^{22} = +92°$ (0.2 per cent. solution in 0.1 N NaOH). By treatment of the synthetic compound with diazomethane, a methyl ester (m.p. 166–167°) was formed which showed no depression in melting point when mixed with a sample of biotin methyl ester. As tested by the yeast-growth method the synthetic biotin exhibited the same degree of activity as natural biotin.[4] Since the resynthesized biotin is identical in melting point, optical activity and biological potency with the natural product, it is obvious that little or no racemization could have taken place during the $Ba(OH)_2$ treatment of biotin. The synthesis of biotin from the diamino compound affords additional and conclusive proof for the cyclic urea structure in biotin. The possible relation of the urea structure of biotin to the affinity of biotin for avidin is being subjected to experimental test.

DONALD B. MELVILLE
KLAUS HOFMANN
VINCENT DU VIGNEAUD

DEPARTMENT OF BIOCHEMISTRY,
CORNELL UNIVERSITY MEDICAL COLLEGE,
NEW YORK, N. Y.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN INEXPENSIVE SQUARE-WAVE GENERATOR

BECAUSE the square wave contains an infinite series of harmonics of its fundamental frequency, and because its precise wave-form is readily recognizable on an oscilloscope it is an easily applied severe test for an amplifier. It shows at a glance the high and low frequency cut-offs, other frequency and phase discrimination, resonance, overshoot, etc.

The generator here described is light, compact,

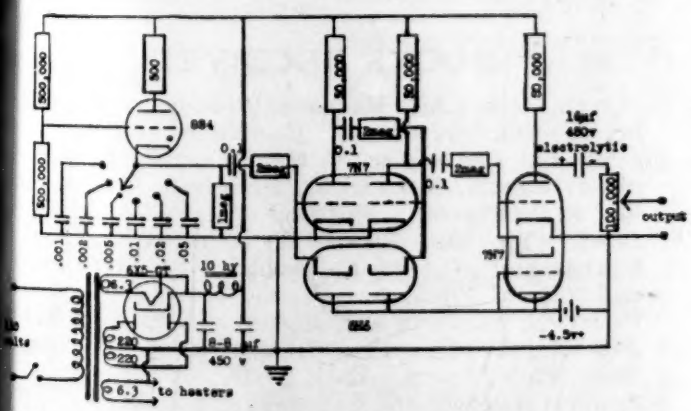

FIG. 1. Circuit of square-wave generator. (Values are not critical.) The 100,000 ohm output potentiometer should be tapered as for an audio gain control.

simple and portable. Its principle is to feed the output of an oscillator first into a limiter which clips off the peaks and gives waves with flat tops and bottoms, thence into an amplifier and second limiter, etc. The sides of the wave become steeper with each amplifier stage.

Frequency stability is provided by the thyratron oscillator. The fundamental is variable in six steps from 35 to 1,200 cycles. The grids of the amplifier tubes together with the diodes constitute effective limiting circuits. The output is variable from 40 volts to less than 100 microvolts by a single control. The rates of rise in the two sides of the square wave are not exactly equal, but the slow one is faster than 10 microseconds. Thus the generator will test an amplifier to over 50,000 cycles.

The power transformer should be a well-shielded one, and should be mounted a few inches away from the thyratron tube to prevent magnetic action on the latter.

CRAIG W. GOODWIN

LABORATORY OF NEUROPHYSIOLOGY,
YALE UNIVERSITY SCHOOL OF MEDICINE

AN ADJUSTABLE RESISTOR FOR FLOWMETERS

ONE of the most common types of flowmeters for air is that consisting essentially of a resistor and a gage for measuring the pressure drop across it. The pressure gage may be a manometer with its two arms connected to the air line, one ahead of and the other following the resistor; or if one end of the resistor is open to the atmosphere, so may be the correspond-

[3] V. du Vigneaud, K. Hofmann, D. B. Melville and J. Rachele, *Jour. Biol. Chem.*, 140: 763, 1941.

[4] We wish to express our appreciation to Miss Eleanor Hague of this laboratory for carrying out the assays.

ing manometer arm. The resistor is often represented diagrammatically as a short capillary, but in practice it takes on a variety of forms, for a simple short section of capillary glass tubing in the readily available bore sizes often fails to provide enough resistance.

The most frequently adopted way of obtaining high resistance, no doubt, is to use a long capillary, sometimes an unwieldy bundle of tubes several meters in total length. A common alternative is to decrease the diameter for part of the path by reworking the glass to form a constriction; a compact element results, but the danger of clogging is increased. A resistor that is both compact and nonclogging may be formed by packing small-bore glass tubing with fine sand, preferably narrowly fractionated as to size—say, 200–325 mesh—and washed free of dust. A resistor recommended by Bruun[1] comprises a short capillary tube containing an exchangeable wire, different magnitudes of resistance being obtainable by use of different sizes of wire in the same tube.

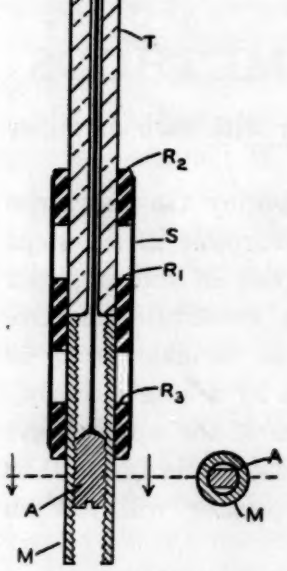

FIG. 1. Resistor in longitudinal section, with cross section of threaded parts.

All these types of resistors have one feature in common that is sometimes a serious drawback. When for purposes of standardization it is desirable to have precisely a given amount of resistance, accurate construction is at best a tedious job, and in some cases practically impossible. This fault is obviated in the device described below.

In this resistor (Fig. 1), as in that of Bruun, resistance is effected by a short capillary containing a corrosion-resistant wire. Unlike Bruun's device, however, the wire (W) extends through somewhat less than the whole length of the glass capillary tube (T), the length of the inserted portion being determined roughly in advance by calculation and subsequently corrected experimentally to a close approximation. The protruding end of the wire is soldered to one end of an adjusting screw (A), which fits within an inside-threaded metal tube (M). The screw is grooved on the other end for operation with a screw driver, and is cut down flat throughout its length on two opposite sides to allow free passage of air through the metal tube. The glass and metal tubes are approximately the same in outside diameter, and are connected closely by one (R_1) of three similar short sections of heavy-wall rubber tubing. The other two sections (R_2, R_3) are slipped around the glass tube and the metal tube, respectively, some distance from the connecting section (R_1). A sheath (S) of springy sheet metal nearly surrounds the three rubber-tube sections, which it grips firmly by reason of its tension, and thereby serves as a splint to hold the assembly rigid. A ready-made article that lends itself admirably to use as the sheath is the spring element of a well-known type of paper clip.

The resistor may be installed in the flowmeter by the use of one or two connections of rubber tubing, depending on whether or not one end is to be left open to the atmosphere. When the assembly is otherwise complete, the wire, having been cut originally somewhat too long, is clipped down to give as nearly as possible the correct resistance when the adjusting screw is about midway between the ends of the threaded tube. Fine adjustment can then be made by turning the screw.

It should be pointed out that in a capillary containing a wire, where both are perfectly straight, the resistance will depend on how nearly centered they are with respect to each other. In practice, however, if the wire is nearly as large as the bore, the tendency of the former to kink will prevent any troublesome variation of the resistor as a whole.

This device has a wide field of usefulness, has a material cost of only a few cents, and is easily constructed without special tools.

ERNEST L. GOODEN

BUREAU OF ENTOMOLOGY AND
PLANT QUARANTINE,
U. S. DEPARTMENT OF AGRICULTURE

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